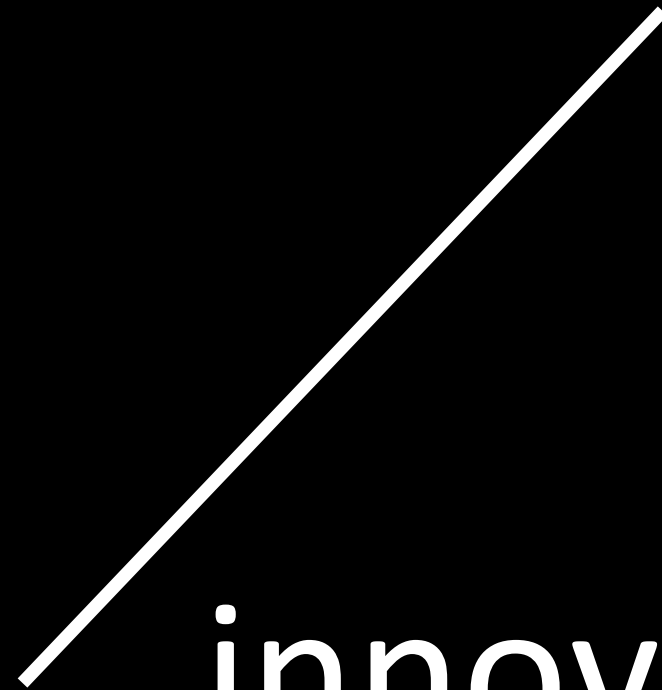


punditry



innovation

“All progress depends on
the unreasonable man.”

- George Bernard Shaw

“Human salvation lies in the hands
of the creatively maladjusted.”

- Martin Luther King

“experts” reality check?

“The telephone has too many shortcomings to be seriously considered as a means of communication.”

- Western Union Internal Memo, 1876

“Heavier-than-air flying machines are impossible.”

- Lord Kelvin, President, Royal Society, 1895

“There is no reason for any individuals to have a computer in their home.”

- Ken Olsen, President, Chairman and Founder of DEC, 1977

Extrapolating the past...

1949: “Where a calculator like the ENIAC today is equipped with 18,000 vacuum tubes and weighs 30 tons, computers in the future may have only 1,000 vacuum tubes and perhaps weigh only 1½ tons.”

The reality...

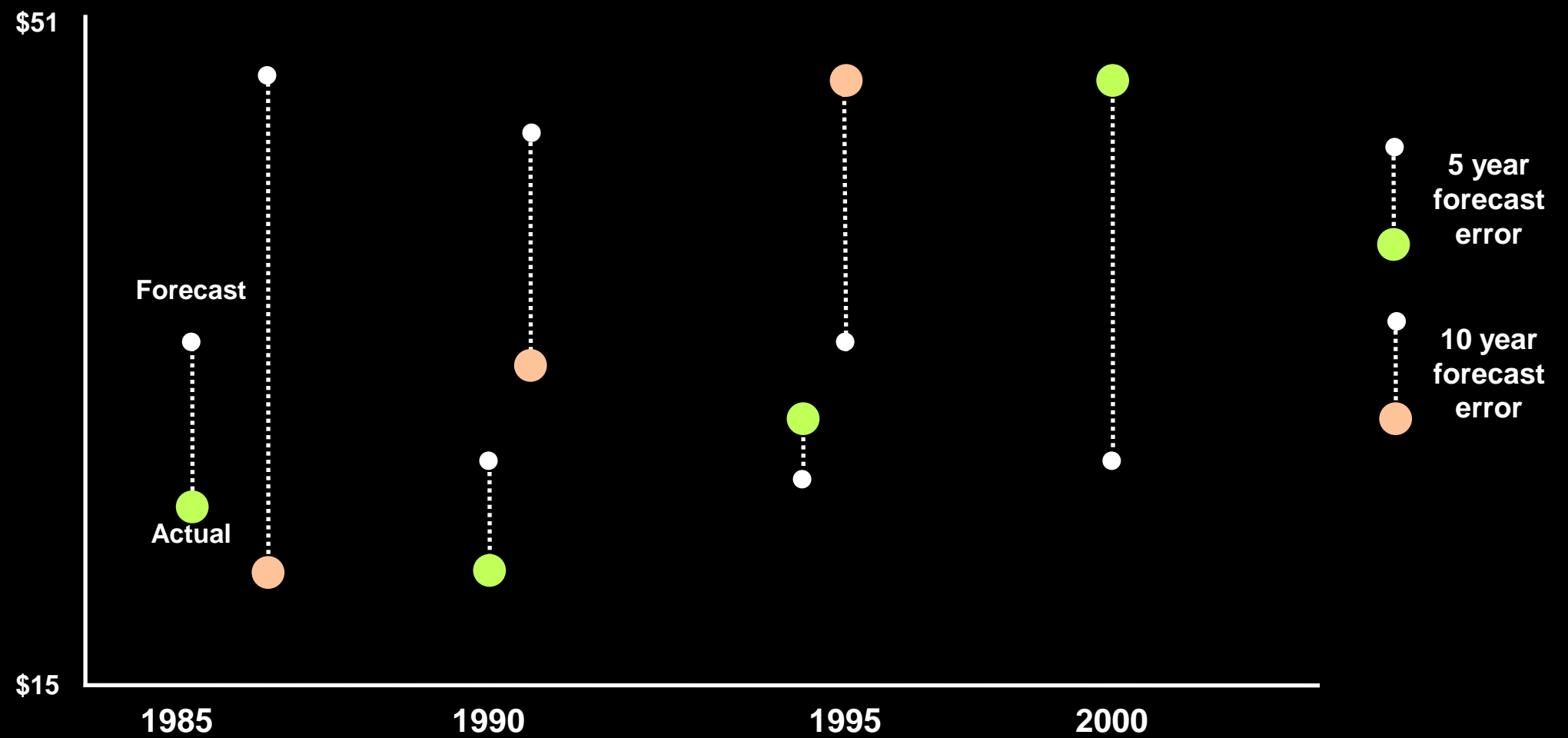


forecasting

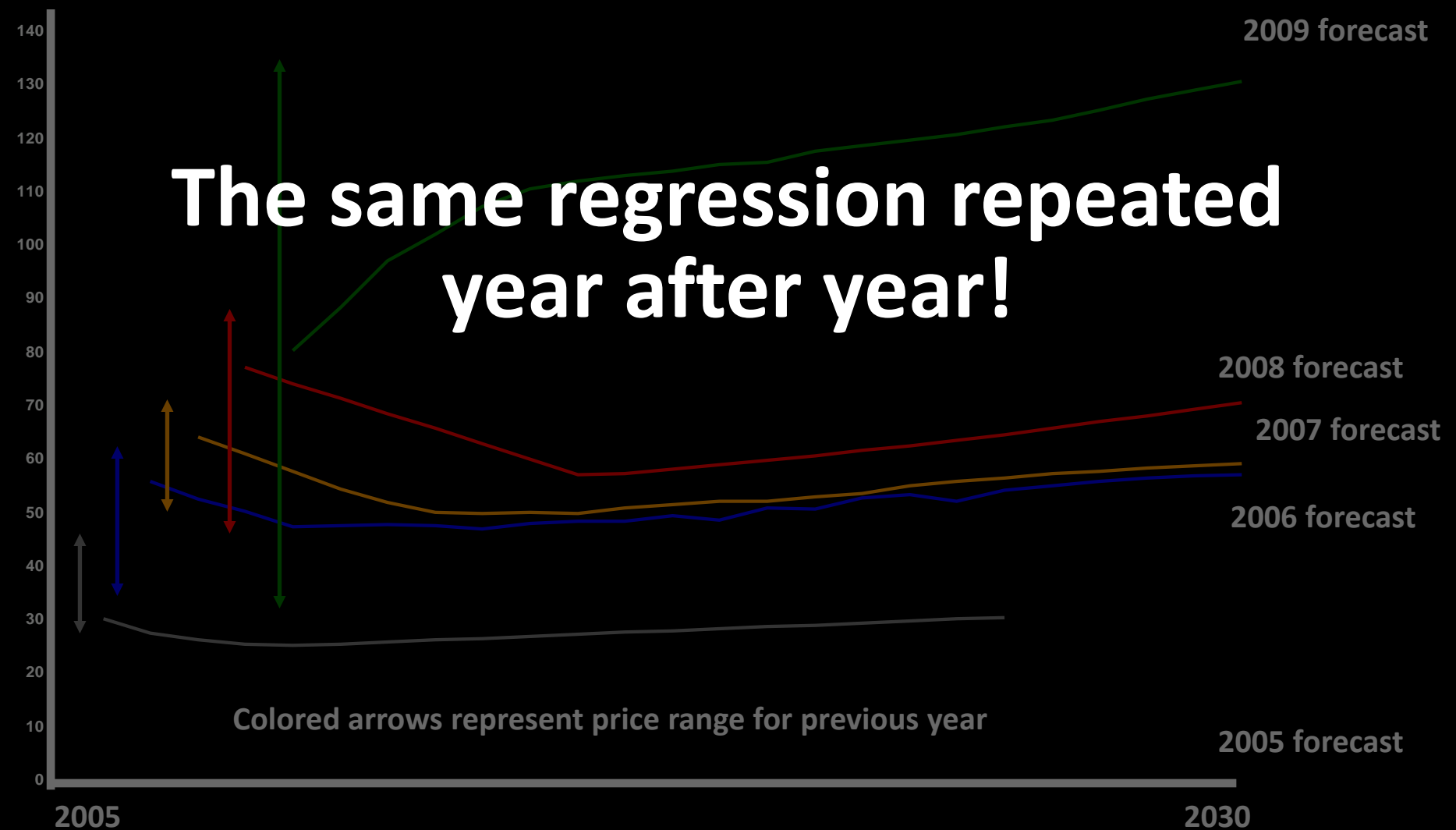
“It is the mark of an educated person to look for precision only as far as the nature of the subject allows.”

- Aristotle

oil price forecasts (1985-2005)



EIA oil price forecasts: 2005 through 2009

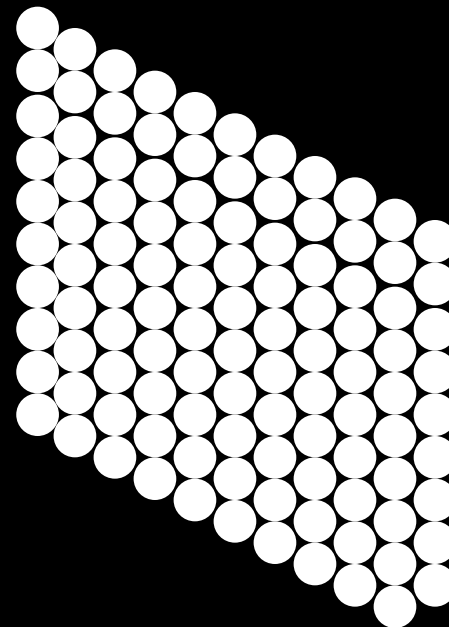


Mckinsey : US mobile subscribers

1980 forecast for 2000



forecast



actual

yesterday's technology, tomorrow's forecast

1980's phone:



year 2000 phone:



quantitative modeling **flaws**

models with given inputs are precise but inaccurate

- **low “standard deviation”, but with high “standard error”**
- **input the measurable, ignore the immeasurable**
- **obscured embedded assumptions**

the folly of predictions: tetlock study

hundred's of experts.

80,000+ “expert” forecasts & 20+ years

**Results: Experts are about as good forecasters as
dart-throwing monkeys**

“relevant scale” solutions for

... oil

... coal

... materials

... (efficiency of oil & coal use)

“...relevant cost”

“...relevant scale”

“...relevant adoption”

evaluation criteria

Trajectory: “What is” or “What Can Be”

Scalability Trajectory

Cost Trajectory

Adoption Risk

Capital Formation

Optionality

Carbon Reduction Capacity

“extrapolation of the past”

VS.

“inventing the future”

redefining swans



“black swan”

...rarity, extreme impact,
and retrospective
(though not prospective)
predictability

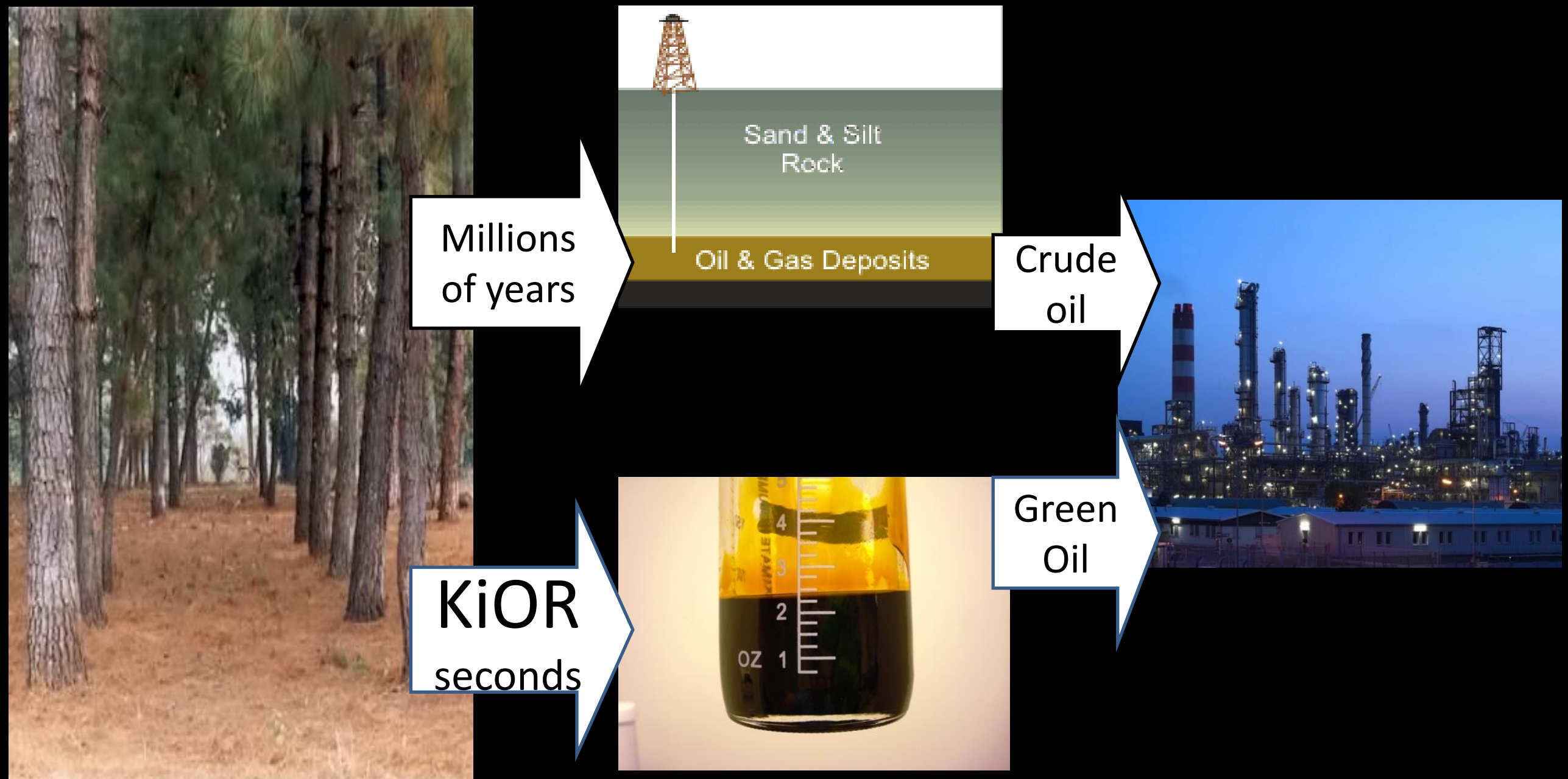
calera

“turning problem carbon dioxide into a feedstock”

KiOR

“a million year crude production cycle reduced to hours?”

The big idea: accelerating nature



ecomotors

“50-100% more efficient engines cutting world oil
consumption in half”

“2X the efficiency improvements of hybrids at 10%
of the cost”

soraa

“10X less electricity use for lighting”

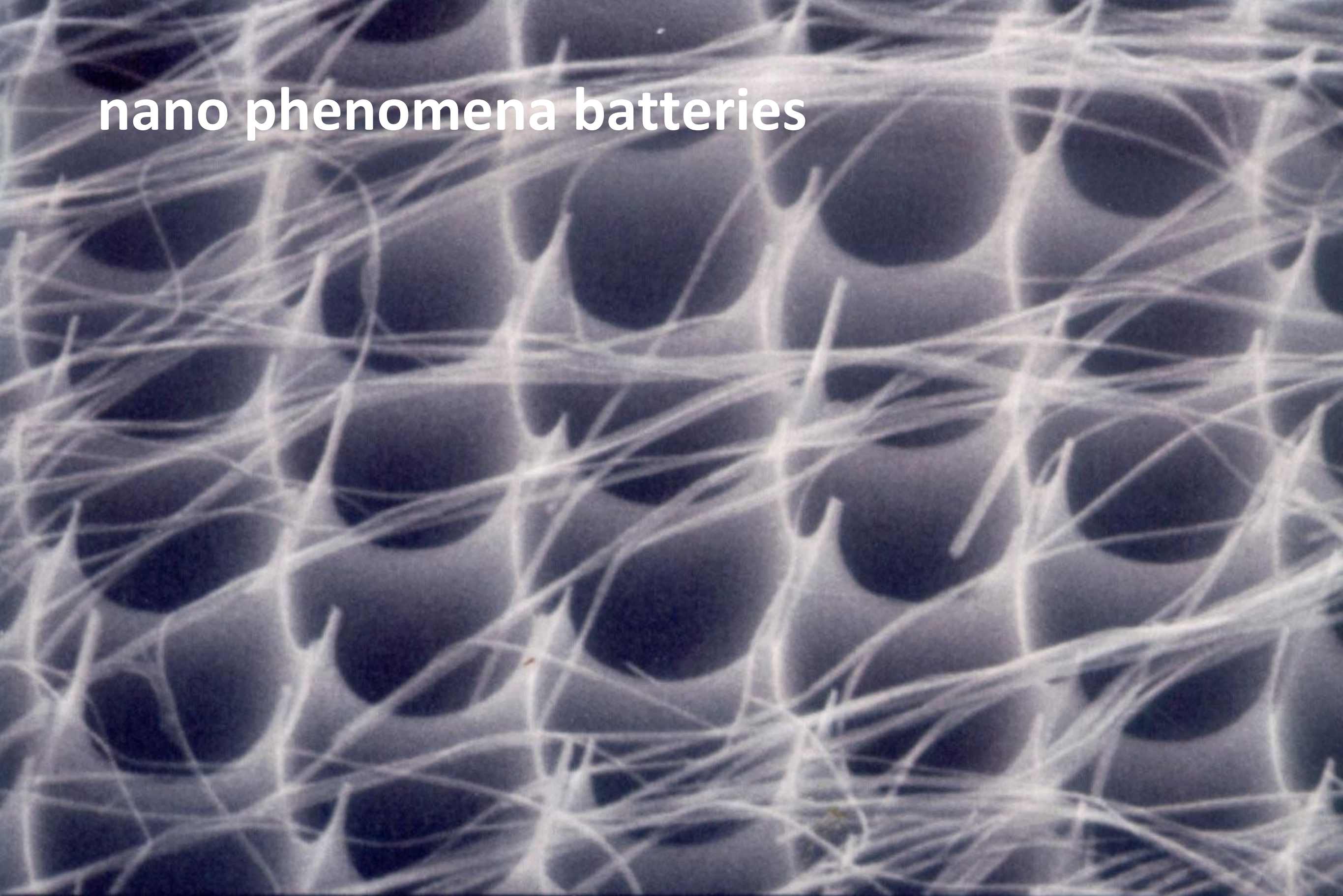
...technology expands the 'art of the possible.'

...today's 'unimaginable' is tomorrow's
'conventional wisdom.'



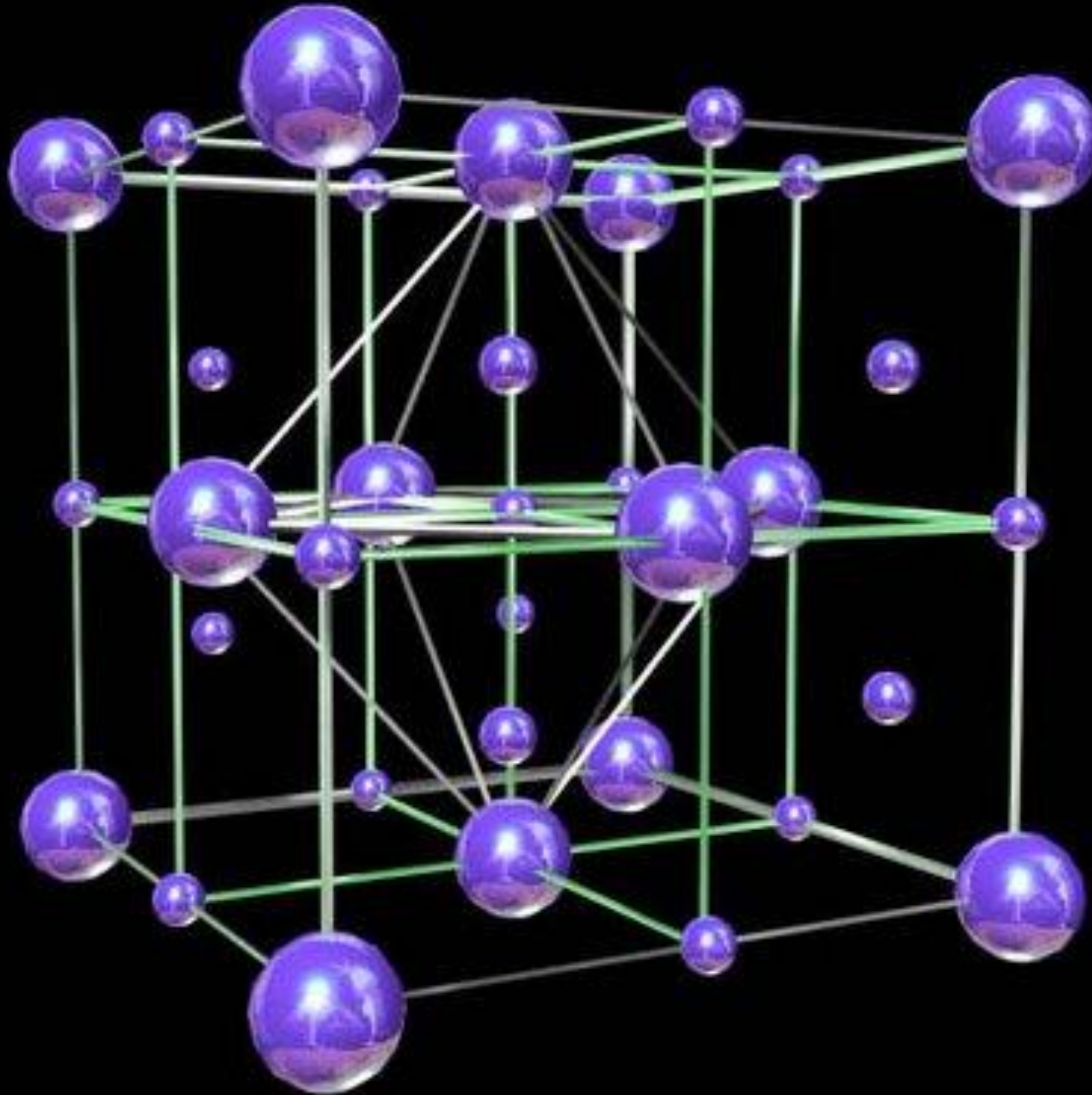
artificial leaves to produce energy?

nano phenomena batteries



10 μ m 15.2kV 5.00E3 0258/45 1

LENR / Desktop Fusion



gasoline/methane from CO₂?



using absorbed light or heat to “convert” CO₂

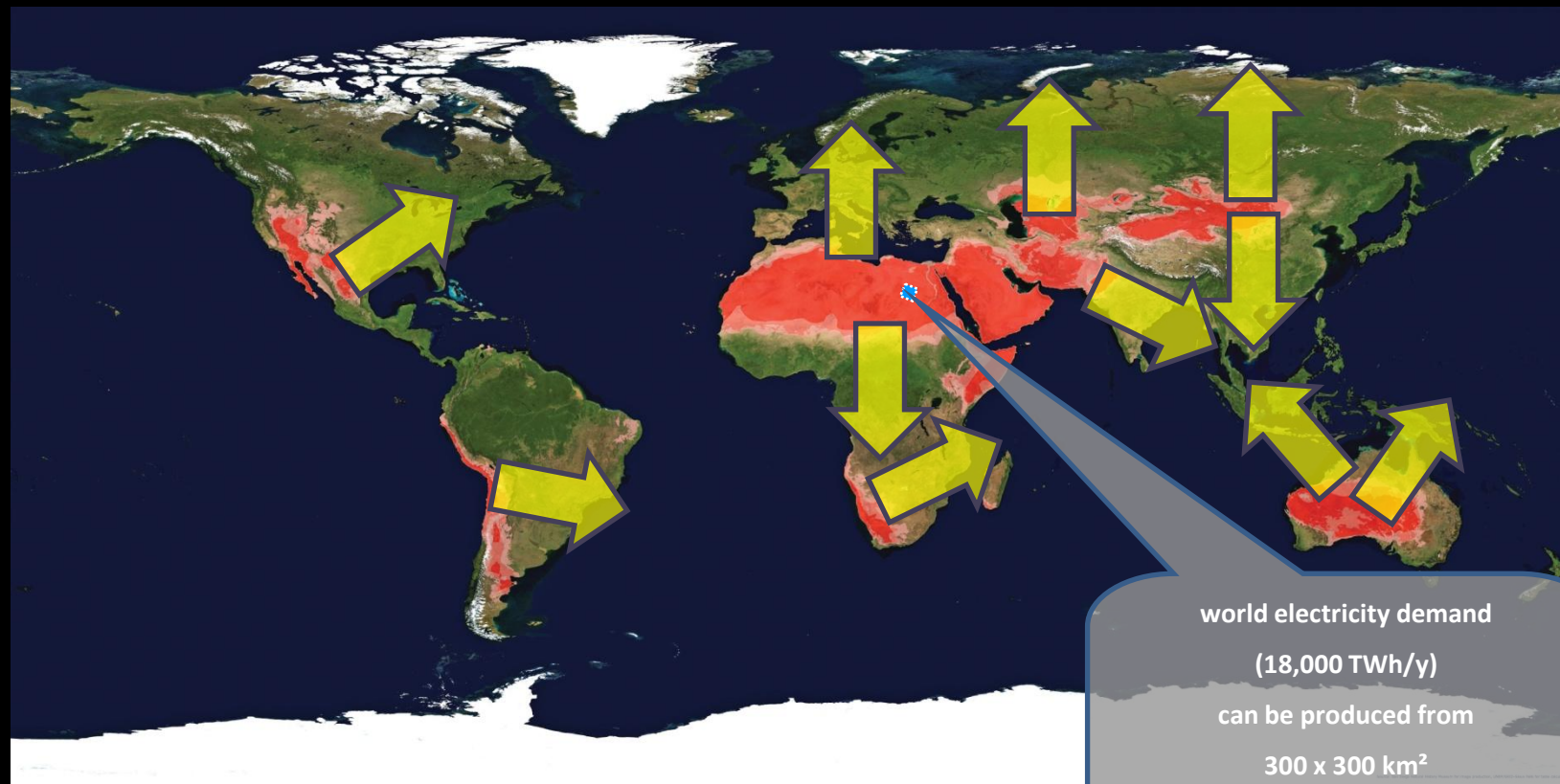
path to black swans...

more shots on goal!

One Billion Acres?

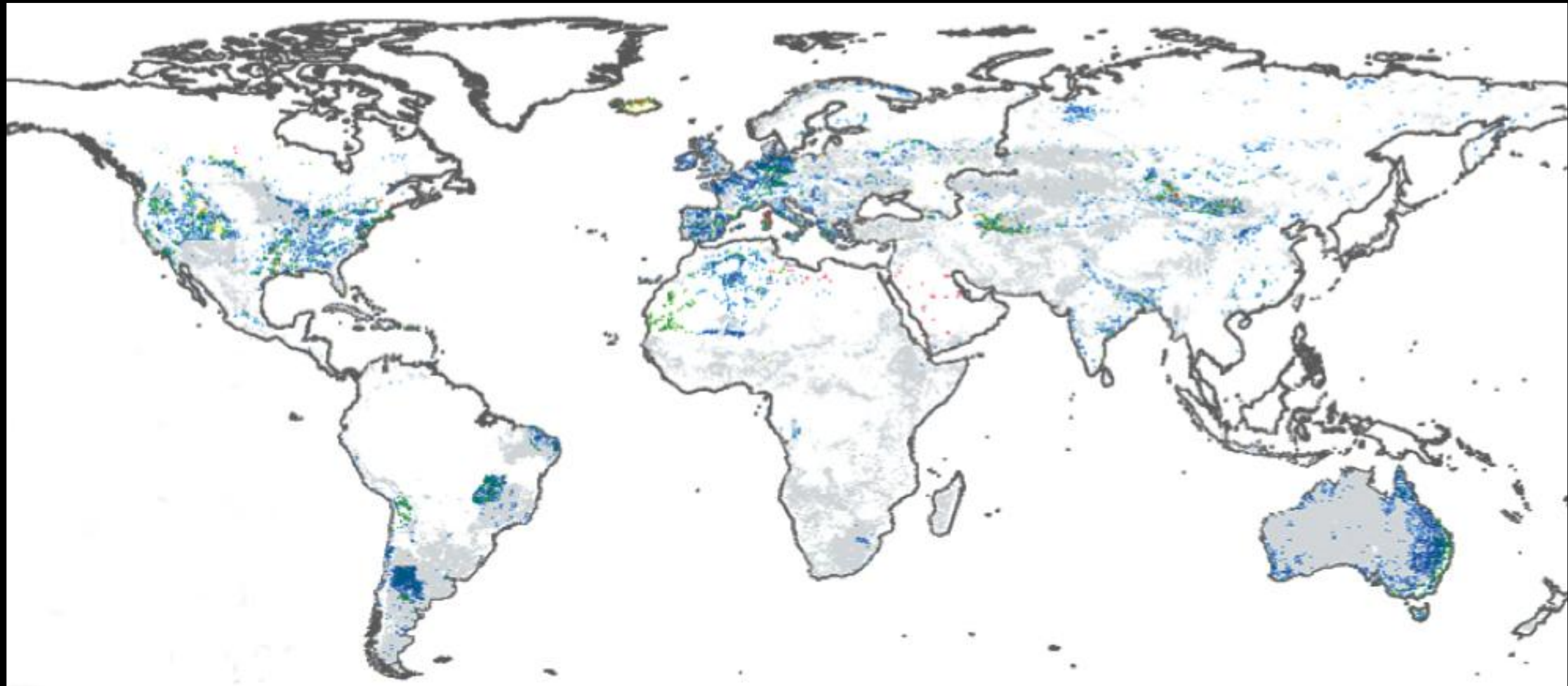
Deserts as solar farms

→ 3000 km



world electricity demand
(18,000 TWh/y)
can be produced from
300 x 300 km²
=0.23% of all deserts
distributed over "10 000" sites

another billion acres...



Area - % former agriculture land abandoned



**yet another billion
acres...**

winter cover crops

**yet ANOTHER billion
acres...**

geothermal

negawatt energy savings!

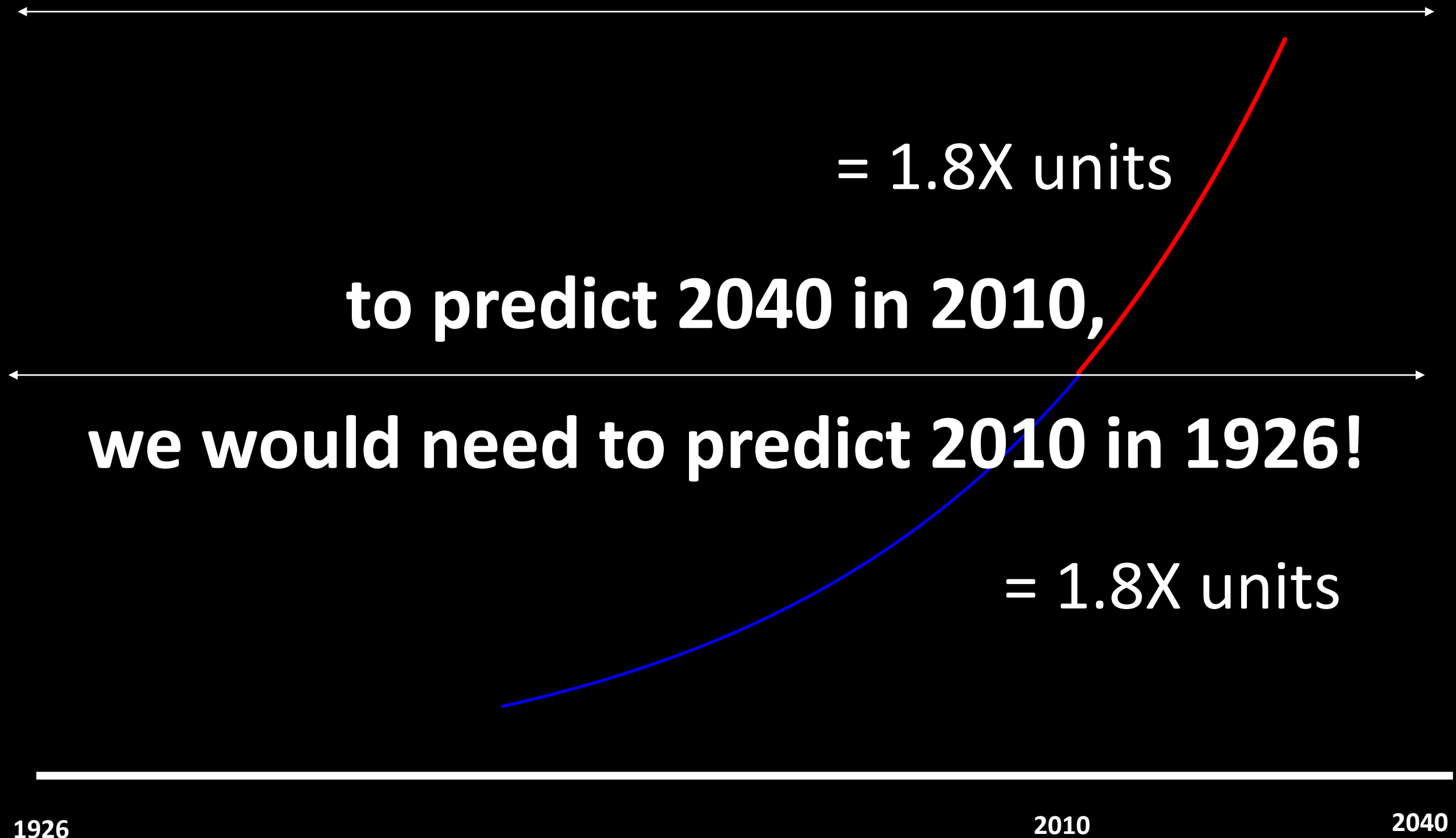
soraa, PAX

negabarrel energy efficiencies!

ecomotors, transonic combustion

exponential innovation...

assuming ~2% rate of change...



as surely as...

1985: **NOT** a PC in every home

1990: **NO** email for grandma

1995: **NOT** the internet

2000: **NO** pervasive mobile

2005: **NO** financial implosion

2010+: reason for optimism

...the sources of innovation

Google, Facebook, Twitter : Fox, NBC, CBS

Ebay : NY Times, Wash Post,....

Amazon : Walmart

First Solar : Shell

Cree : GE

ABI : J&J

Juniper : Lucent

Netscape : IBM

.... **policy/fashion**

... smart grids: 10% solutions?

... zero energy buildings: reverse scale economics?

... electric cars or coal powered cars?

... low carbon electricity or renewable electricity?

... hundreds of billions of dollars?

.... evaluation

... not “conventional wisdom” : CCS

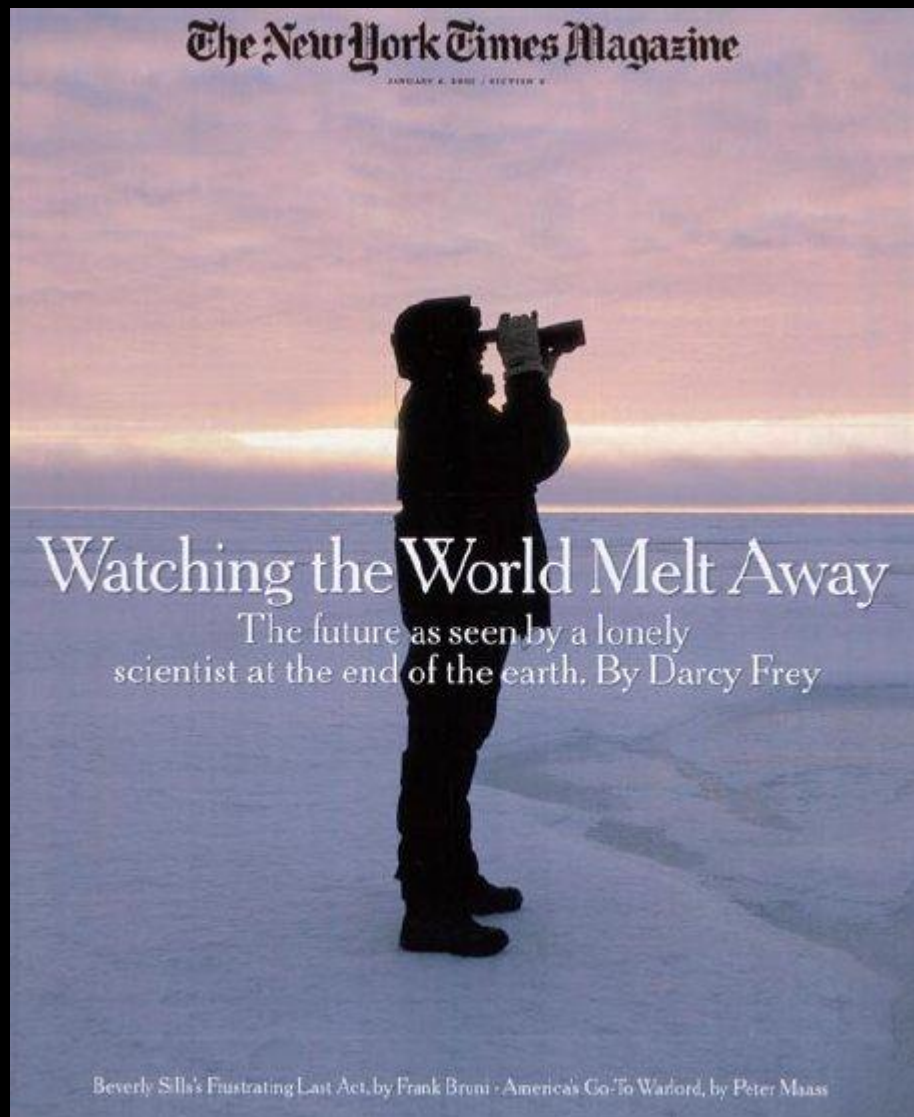
... Greeconomics vs. Economics

... big company vs. startup bias

... static vs. dynamic view: E85 engines

... Pragmentalists vs. Environmentalists vs. Pundits

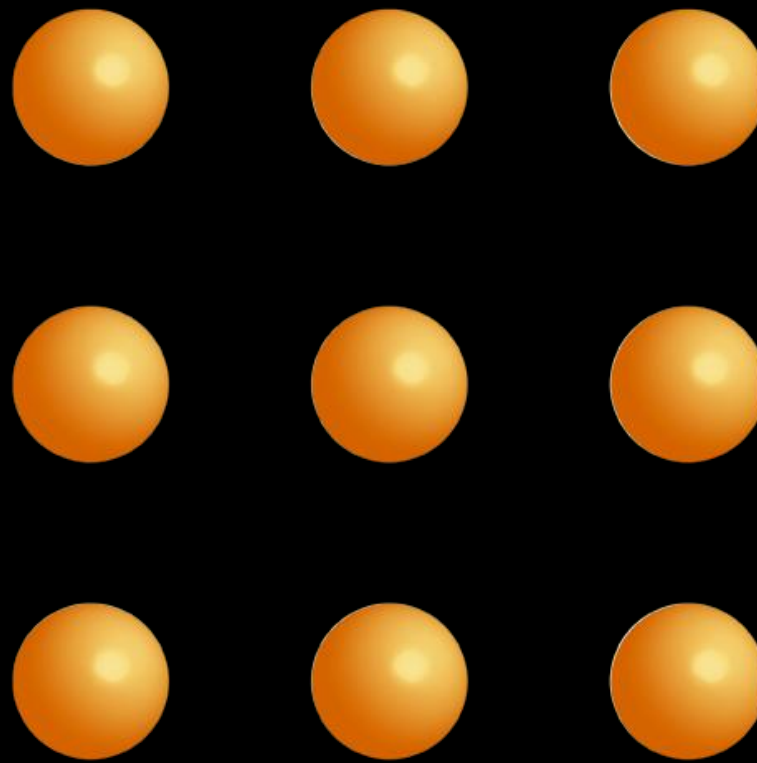
to predict the future,
invent it!



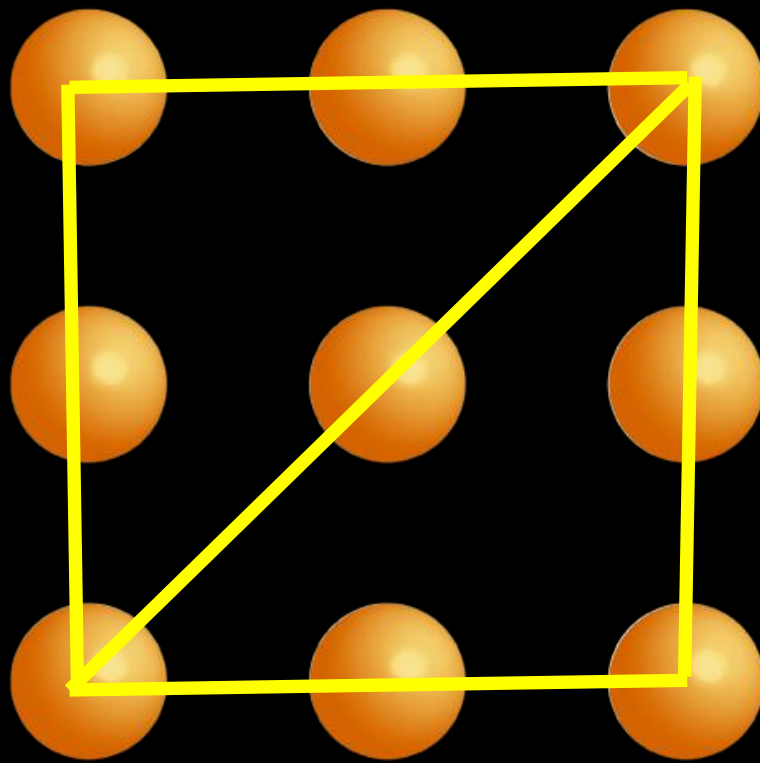
... or get to **work.**

vk@khoslaventures.com
khoslaventures.com/resources.html

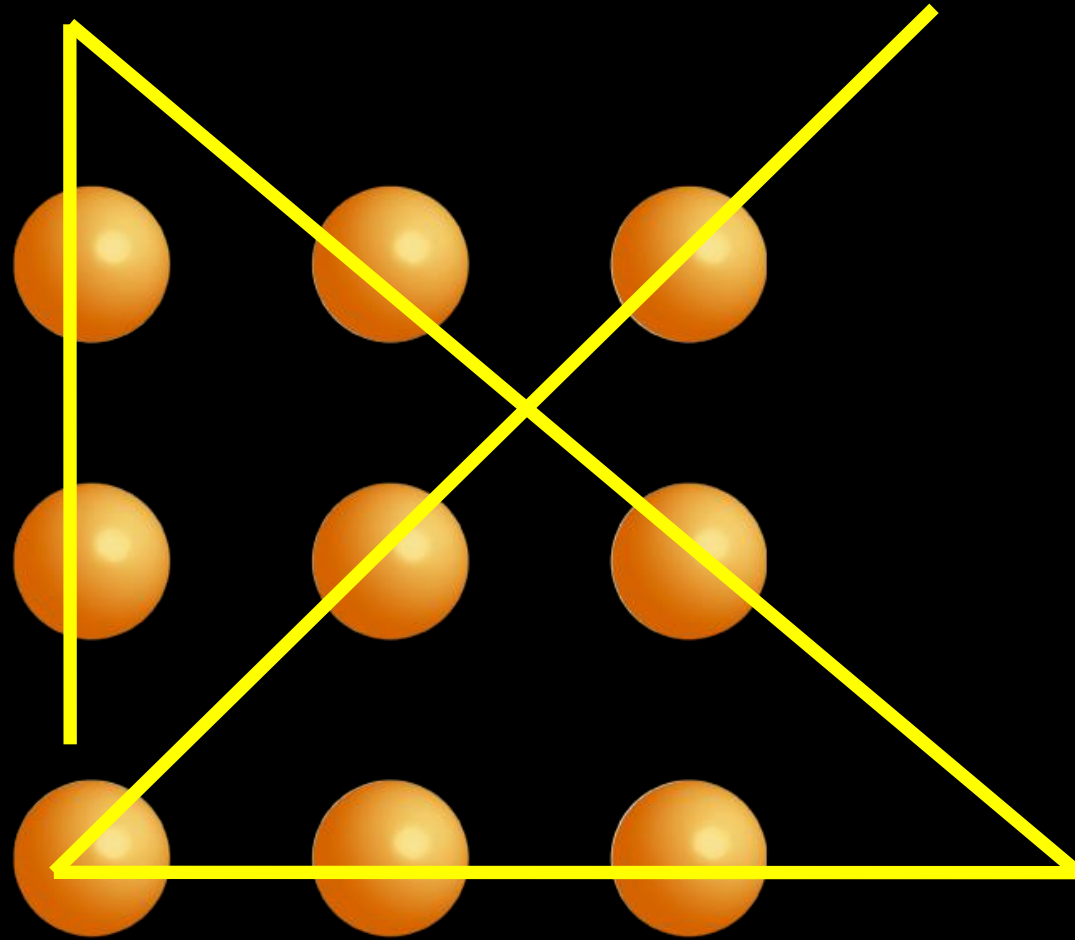
nine dots problem



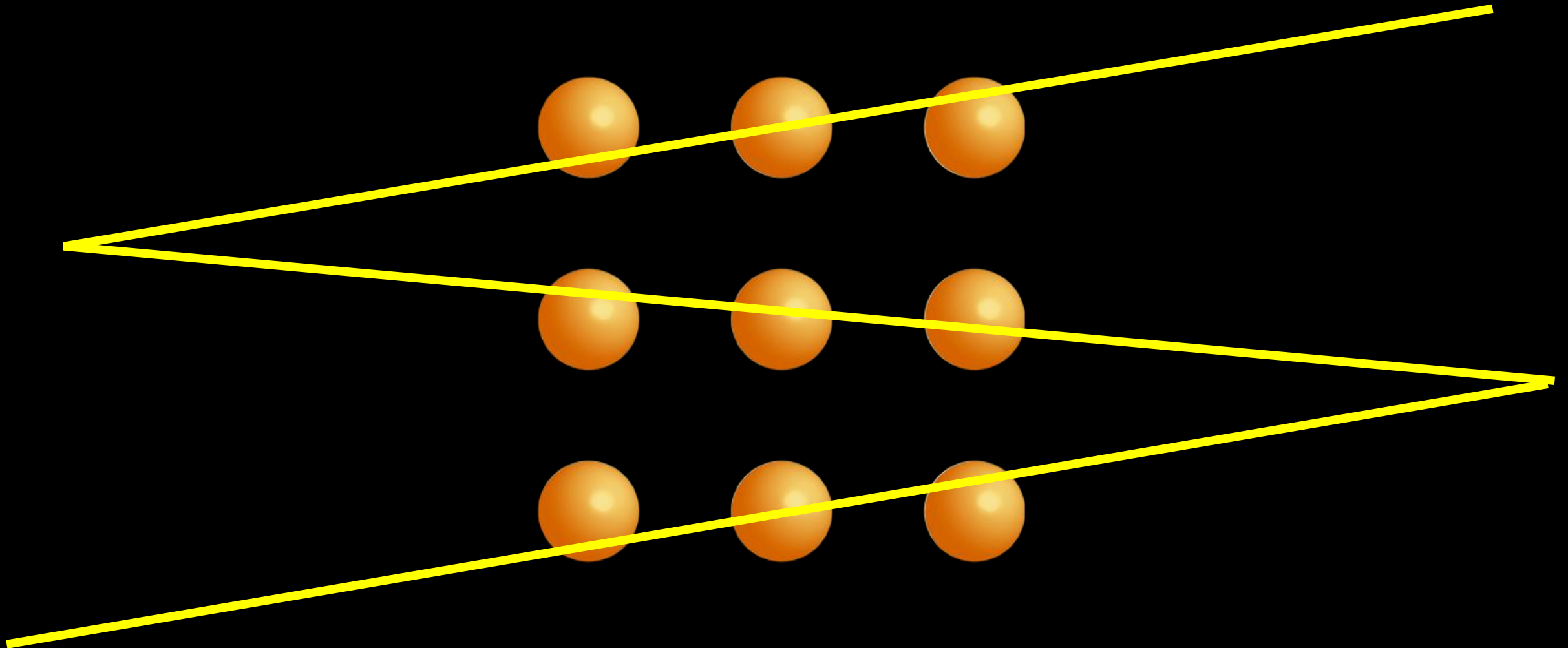
standard nine dots solution



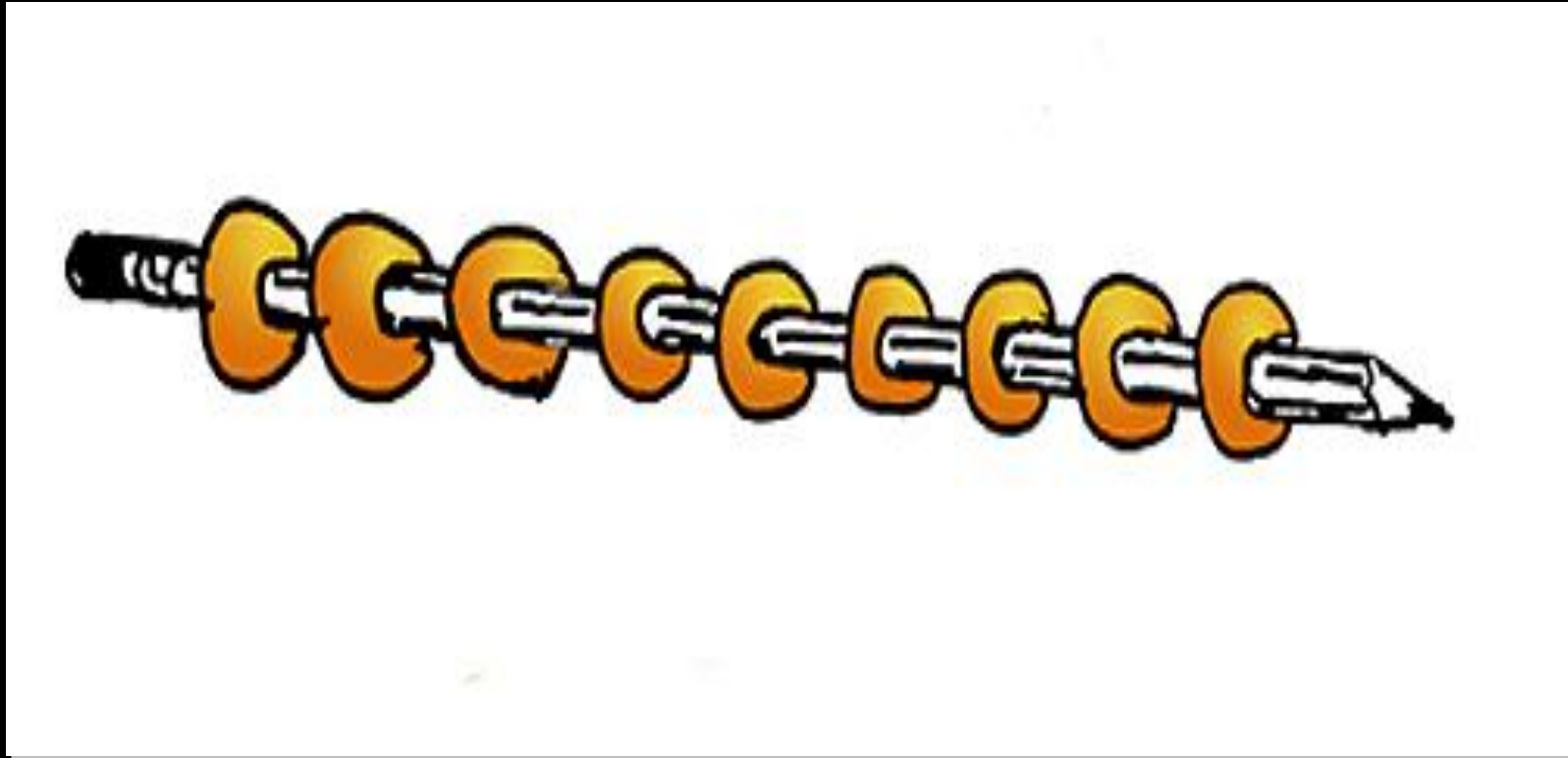
standard nine dots solution



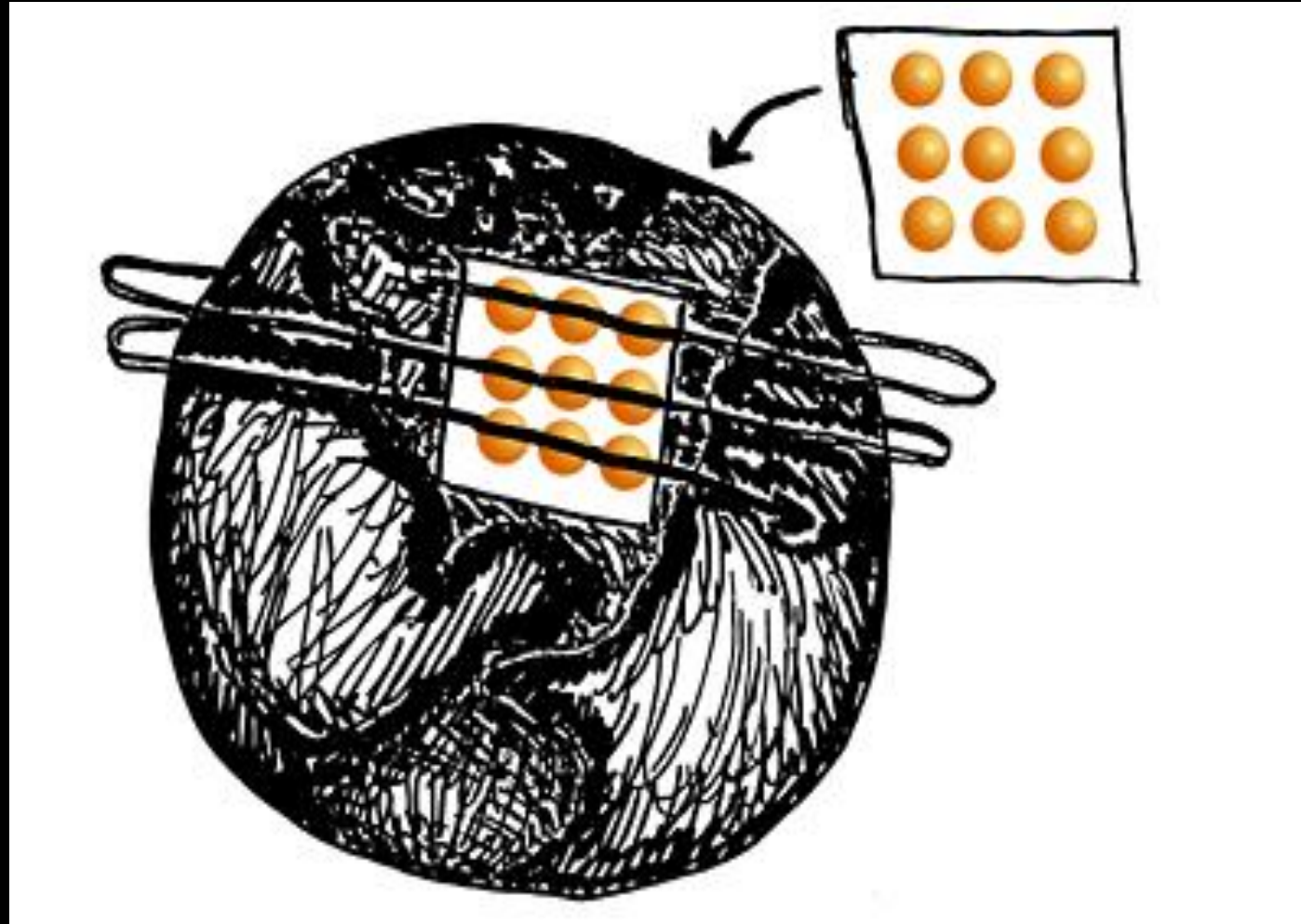
better: use just three lines



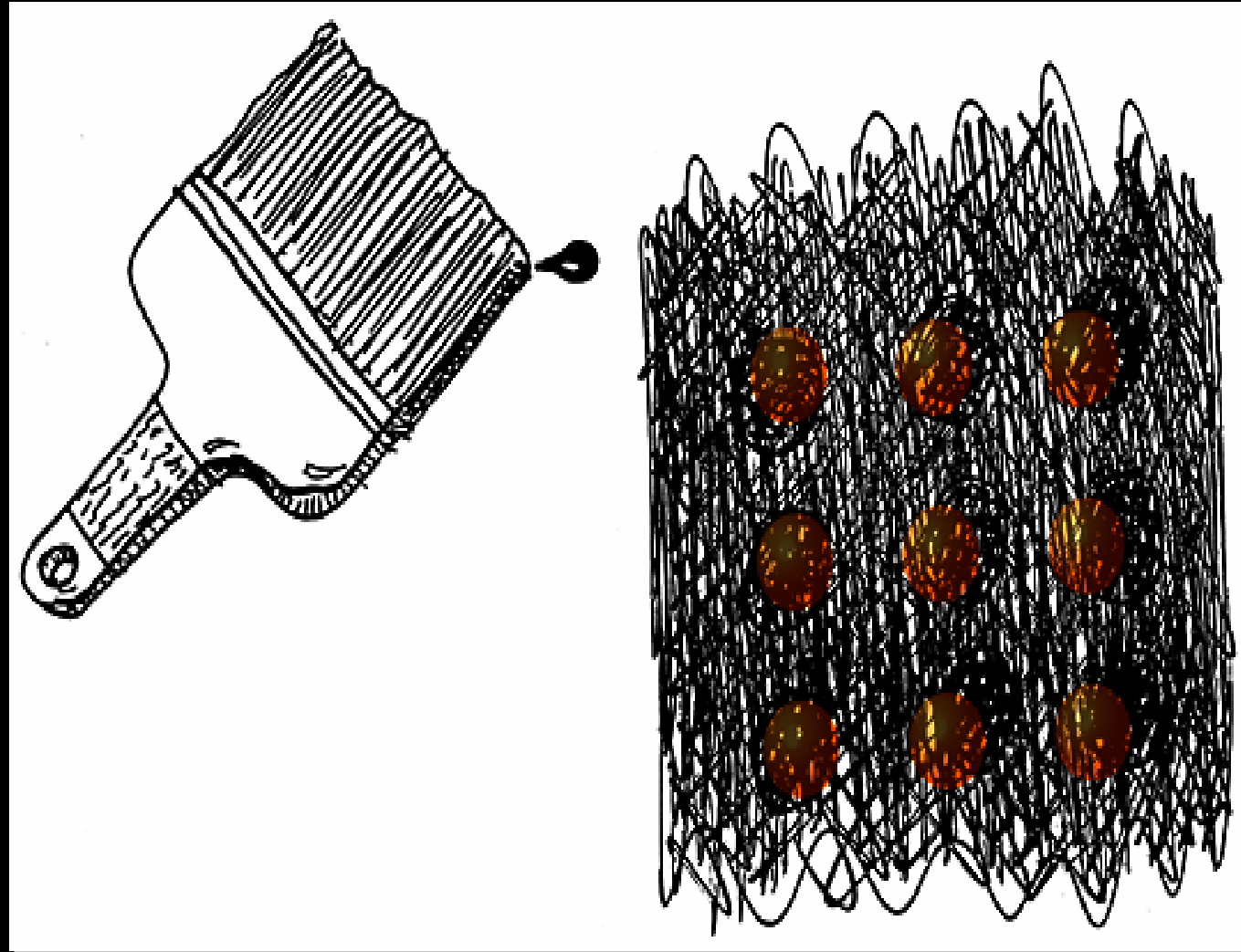
mechanical engineer's solution



geographer's solution



wide line solution



“...every strategic inflection point [is] characterized by a ‘10X’ change ...”

“There’s wind and then there is a typhoon, there are waves and then there’s a tsunami”

- Andy Grove